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know of. But in its original state, a skin of ordinary size is easily torn into strips. When dressed, the fibres being loose, come gradually into parallelism, and the tension is resisted by many at once. Previously, held to its place by the gluten, each fibre, acting singly, was readily broken.

Here is a problem for hunters. *With a single bullet, to shoot a deer through the heart and break both fore legs, one of them just above the foot.* It has been solved. But how?

THE HABITS OF SPIDERS.

BY J. H. EMERTON.

EVERY reader of the NATURALIST has noticed the round, regularly formed spider-webs which often adorn the corners of fences, and the windows of neglected buildings; but few, perhaps, have had time or patience to watch the skilful manner in which they are constructed, or to examine the apparatus by which the spider spins the thread out of her own body. The builders of these webs belong to a large family of spiders, the Epëiridæ. They are found in all parts of the world where winged insects, which form their food, abound.

To illustrate the habits and structure of these spiders, we will select one common species as a representative of the whole group, and confine our observations to it. This species, the *Epëira vulgaris* of Hentz, seems to be common all over the United States, and is represented by closely related species in other countries. It is seldom found in the woods and fields, but lives in great numbers on garden fences and trellises; in barns, and on the framework of bridges, the structure of which affords numerous crevices for shelter and concealment. When fully grown it is half an inch in length, and its feet, when extended, will cover a circle an inch and a half in diameter. It is clothed with hair of a greyish color, the back is ornamented with various whitish markings, and the legs with rings of black and yellow. The under side of the body is black, with yellow markings. In sheltered places they spend most of the time in their webs waiting for prey, while in situations exposed to the sun and wind they watch only in the night. During the day, and in stormy weather, they remain concealed in some crack or corner, near which, for convenience, the web is always placed. In such retreats they also pass the winter without food, and only covered by a thin web of their own spinning. Like other spiders they are furnished with poisonous jaws, which they attempt to use when disturbed, but as they can only bite what comes directly between their jaws, they may be handled without fear. There are but few cases on record of a spider biting the human skin. Their timid nature leads them to avoid danger rather than resist it, and the common suspicion with which they are regarded has no foundation, except a want of acquaintance with their habits.

If we take a spider of the kind just described and turn it under side up, as in Pl. 11, fig. 2, we shall at once notice that the body consists of two nearly equal parts, connected by a slender waist. The front part gives origin to the organs of sense and motion, while the hinder part contains the principal internal organs. The most conspicuous appendages of the body are the four pairs of legs (Fig. 2, *a*, *a*, *a*, *a*). Immediately in front of these is another smaller pair (Fig. 2, *b*, and fig. 7), the first joints of which are flattened, so that they may be used as jaws, or lips (Fig. 2, *c*), for squeezing the food. The ends of these last limbs are supposed to be organs of touch, and are called palpi. Next in front is a pair of stout jaws (Fig. 3, *c*, *c*), each of which is furnished with a sharp claw at the end (Fig. 3, *a*). This claw is hollow, and is pierced with a minute hole near the point (Fig. 3, *b*). When the spider bites, a drop of poison is discharged through this orifice from a gland in the head. This quickly kills insects, and causes inflammation of the bitten part in larger animals. On the front of the head are the eight eyes, four near together in the centre, and a pair on each side (Fig. 3).

The feet of spiders are wonderfully adapted for walking on the web. Each foot is furnished with three claws (Fig 6, *a*, *b*, *b*), the middle one of which (*a*) is bent over at the end, forming a long finger for clinging to the web, or for guiding the thread in spinning. The outer claws (*e*, *e*) are curved and toothed like a comb. Opposite the claws are several stiff hairs (Fig. 6, *c*) which are toothed like the claws, and serve as a thumb for the latter to shut against.

The spinning organs are three pairs of fleshy appendages situated at the posterior end of the body (Fig. 2, *e*). When not in use they are folded in towards each other, the third pair covering the second. When expanded, they appear as in Fig. 4. The end of each of these spinners (*s*, *s*) is covered with minute jointed tubes, like Fig. 5, which represents one tube much enlarged. Inside the spider, and connected with the spinners are several bunches of glands, which secrete a liquid like the white of an egg. To form the thread this liquid is drawn through the tubes, which divide it into such small fibres that it dries almost immediately on coming in contact with the air. The spider has the power of uniting these fibres into one or several threads, according to the purpose for which they are to be used. The thread commonly used for the web is composed of hundreds of simple fibres, each spun through a separate tube. As the thread runs from the body, it is guided by the hind feet, which hold it off from contact with surrounding objects, until the desired point is reached, when a touch of the spinners fastens it securely.

When a spider wishes to build a web she usually selects a corner, so that the structure may be attached on several sides. She then runs a few threads along the objects to which the web is to be fastened, to facilitate her passage from point to point. The web is commenced by a line or two across the point where the centre is to be, which is not usually the geometric centre, but nearer the top than the bottom. Radiating lines (Pl. 11, fig. 1, *b*, *b*, *b*) are then spun from the centre in all directions. In doing this the spider often crosses from one side of the web to the opposite, so that the finished portion is always tightly drawn, and the tension of the completed web is the same in every part.

Having finished the framework, the spider begins near the centre and spins a thread (Fig 1, *c*, *c*, *c*), spirally, around the web to the circumference, fastening it to each radius as it crosses. The distance between the spirals varies with the size of the spiders, being about as far as they can reach. This spiral thread serves to keep the parts of the web in place during the rest of the process, and is removed as fast as the web is finished. It also furnishes a ready means of crossing from one radius to another where they are farthest apart. All the thread spun up to this stage of the process is smooth when dry, and will not adhere if touched with a smooth object.

The spider having thus formed the web, begins to put in the final circles at the outside, walking around on the scaffolding previously prepared, which she gradually destroys as she proceeds, until in the finished web only a few turns in the centre are left. The thread of the circles last spun is covered with viscid globules, strung upon it like beads at short distances. If an insect comes in contact with the thread, it immediately adheres, and its struggles only bring a larger part of its body into contact with the web. Dust and seeds also stick to the web, so that in a single day it is often so clogged as to be of no farther use. The web also becomes torn by the struggles of the prey, and by wind and rain, so that it requires repair or renewal every night. In mending a web the spider usually removes all except the outside threads, biting them off and rolling them into a hard ball between her jaws, so that when released it will drop quickly to the ground. This probably gave rise to the opinion, sometimes advanced, that the old web is eaten by the spider.

When the web is finished she stations herself in the centre, where a small circle is left free of the adhesive threads.

Her usual position is head downward, with each foot on one of the radii of the web, and the spinners ready to fasten themselves by a thread at the least alarm. She often remains in her hole with one foot out, and resting on a tight thread connected with the centre of the web, so that any vibration is quickly detected. If the web be gently touched the spider will rush into the centre, and face towards the disturbed part. She will then jerk smartly several of the radii leading in that direction, to see if the intruder is a living animal. If this test is followed by the expected struggle she runs out towards the victim, stepping as little as possible on the adhesive threads, seizes it in her jaws, and as soon as it begins to feel the effects of the bite, envelops it in a silken covering, and hangs it up to suck at her leisure. In spinning this envelope the insect is held and turned around mainly by the short third pair of feet, while a flat band of threads is drawn from the spinners by the hind pair working alternately like the hands in pulling a rope, and wound over it in every direction, so that in a few seconds it is so covered as to be unable to move a limb. When a web is shaken by the wind, the spider will sometimes draw in all her feet toward her body, thereby tightening the web in every direction so that the vibration is prevented.

The construction of nets for catching food is not the only use of the thread made by these spiders. They seldom move from place to place without spinning a line after them as they go. They are able by its use to drop safely from any height, and when suspended by it are carried by the wind across wide spaces without any exertion on their part, except to let out the thread. The crevices in which they pass the winter, and the leisure hours of summer, are partly lined and enclosed by a coating of silk resembling that used for confining captured insects. The eggs are enclosed in a cocoon of the same material, and there the young remain until they are strong enough to shift for themselves, growing to nearly double their size without apparent nourishment.

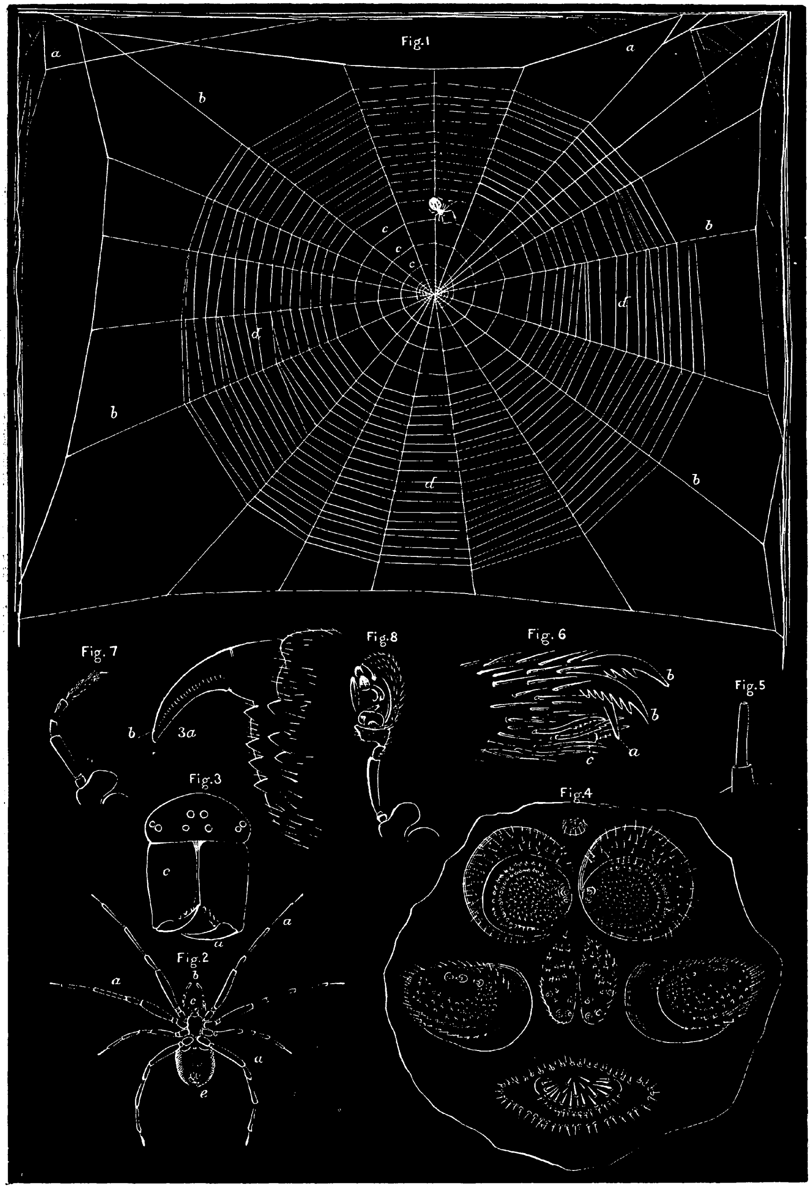
Fig. 1
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Fig. 8
Fig. 6
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Fig. 3
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Fig. 4

Several hundred young are produced by a single female, but probably it is seldom that one-tenth of this number ever reach adult size. Nearly all the spiders which we see in webs are females, or young. They spend most of their time in the vicinity of their webs, and many doubtless pass their lives within a few yards of the place of their birth. The adult males are seldom seen building or occupying webs : they remain concealed during the day, and at night wander about from web to web. When young, there is no obvious difference between the sexes, but as the time for the last moult approaches, the ends of the palpi of the male swell to several times their former size. When the time for the final moult arrives, both sexes retire to their holes and cast off the skins of their entire bodies, even to the claws. This process obliges them to remain concealed until the new skin has acquired sufficient strength and firmness, when they again return to their webs. The females still resemble the young, except in size, but the males are distinguished from them by the greater length of their limbs, the diminished size of the posterior half of the body, and the large and complicated joints at the ends of the palpi (Pl. 11, fig. 8). The females of some species of spiders are said to devour the males whenever opportunity offers, but we have never noticed that habit in this species, though we have often seen a female charge upon an intruding male, and chase him from her web.

EXPLANATION OF PLATE XI.

Fig. 1. Circular web; one-fourth the natural size.

Fig. 2. *Epëira vulgaris* Hentz, natural size, under side; *a*, legs; *b*, palpi; *c*, jaws; *e*, spinners.

Fig. 3. Front view of head, showing eyes and jaws; *a*, tooth on the end of jaw; *b*, orifice for the discharge of poison.

Fig. 4. Spinnerets spread apart for use, showing the cluster of tubes on the end of each, enlarged twenty-five diameters.

Fig. 5. One spinning tube, still more enlarged.

Fig. 6. Foot; *a*, the middle claw; *b*, *b*, the two outer claws; *c*, toothed hairs.

Fig. 7. Palpus of female or young.

Fig. 8. Palpus of adult male.